THE OVERLOOKER'S AND STUDENT'S

GUIDE TO THE RING-SPINNING FRAME

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TO THE

RING-SPINNING FRAME

BY

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PREFACE.

In bringing this book before the trade it is necessary only to point out that although many works on cotton-spinning have already dealt with the Ring-Spinning Frame, there is no book which deals exclusively with this department of the industry. Hence expensive books have to be bought, the greater part of the expense of which is caused by extraneous matter of little or no interest to the student of Ring-Spinning. The rapid and continuous progress of this form of cotton-spinning justifies a separate treatise, which will satisfy the operative's desire for knowledge and enable him to discharge his duties with ease and credit to himself, and with satisfaction to those above him. The rules given are simply expressed, and are illustrated by examples, and any person with a rudimentary knowledge of arithmetic may gain proficiency in a few hours. The book contains, without anything redundant, all that is required to be known by the overlooker in a Ring-Spinning Mill, or by the student aspiring to such a position.

N. B.

Ashton-under-Lyne,
August, 1911.

CONTENTS.

THE RING-SPINNING FRAME.

THE ring-spinning frame is probably one of the simplest and most easily understood machines in a cotton mill. On the introduction of the ring frame into the cotton spinning industry, this machine was thought by many of its early advocates to be the herald of a decided change in the system of spinning cotton yarn, and that the self-acting mule would only be called into requisition to deal with such yarns as are in small demand; but hitherto these expectations are far from being realized.

The ring frame is a double-sided frame and each side contains a long row of spindles suitably spaced and carried by strong rails, known as the ring rails. The spindles are driven by bands from the tin rollers, the band passing from the wharve of one spindle over the top of the nearest tin roller and on round the farthest tin roller, and then round a wharve on a spindle on the opposite side of the machine. It must be understood very clearly that one string drives two spindles. The driving of the machine takes place through one of the tin-roller shafts which extends a little outside the machine, known as the gearing end of the machine, and upon this shaft are the fast and loose pulleys which receive their motion from the line shaft.

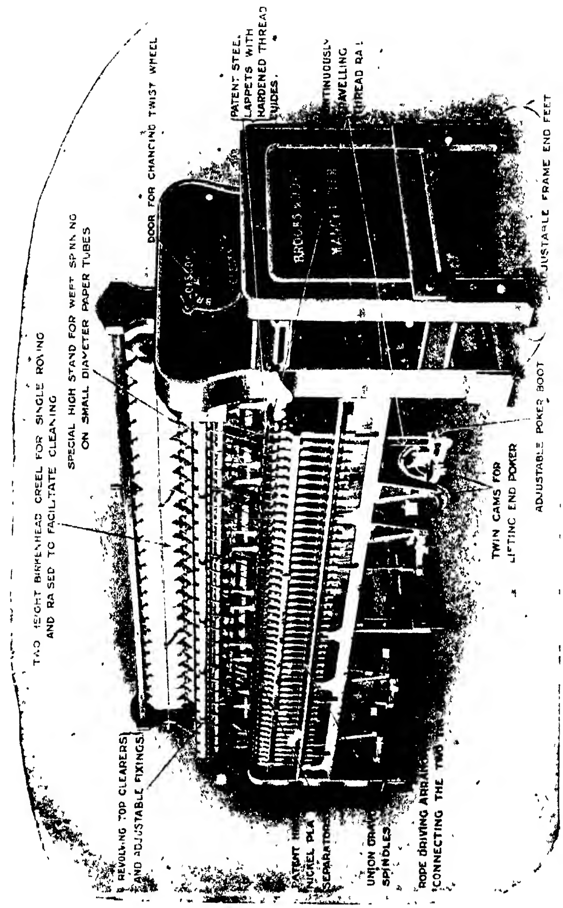


FIG. 1.—Ring-Spinning Frame for Weft Yarn.

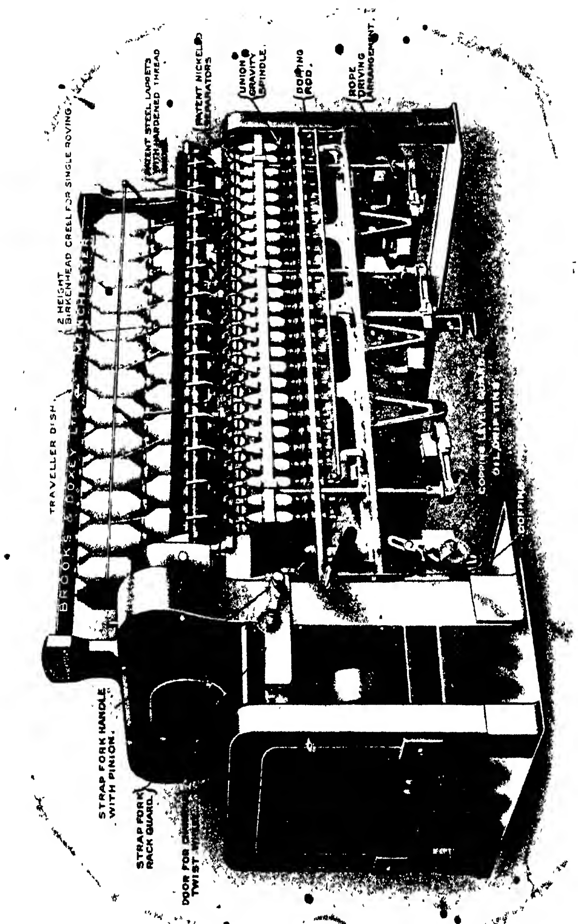
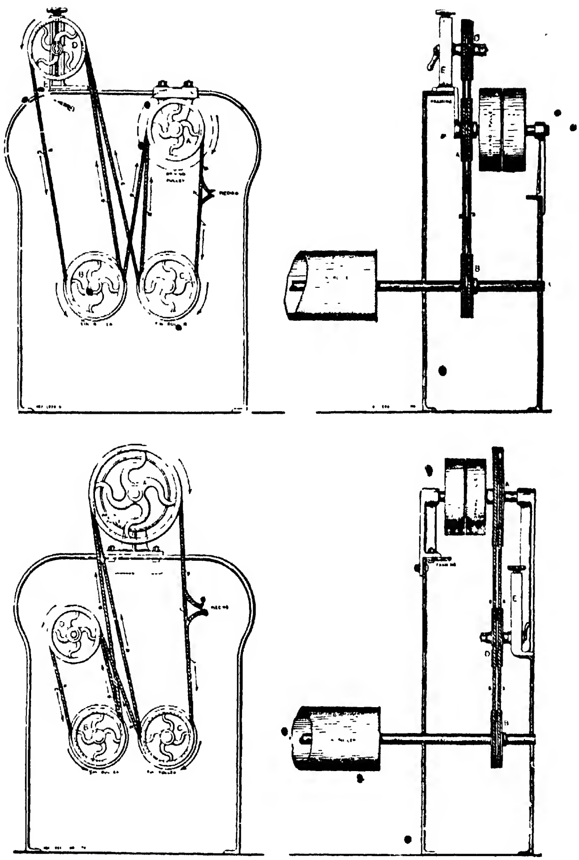


Fig 2.—Ring-Spinning Frame for Twist Yarn.

The second tin roller is usually driven by the frictional contact of the spindle bands.

In some cases a system has been adopted of driving the second tin roller by means of a rope, driving with a tightening pulley, very similar to the taking-up band of a mule. One firm of machinists has adopted a system similar to the rim band of a mule; and the fast and loose pulleys in this latter case are not upon the tin-roller shaft, but upon a shaft situated much higher on the framing, upon which is a pulley very similar to the rim pulley of a mule. This pulley is made changeable to give wider variation in twist per inch. In this case the tin rollers receive their motion from this driving or rim pulley, the band passing round a pulley on each tin-roller shaft and then round a tightening pulley, which keeps it at a proper tension. But when rope driving is applied, more driving power is required. It has also to be paid for as extras on the machine.

The ring frame has certainly made great and rapid progress and proved itself well adapted to the spinning of low and medium counts. It possesses several advantages over the mule, such as economy in wages, reduction in floor space occupied for the same number of spindles, less risk of fire (thus lessening the premium for insurance), and a greater production per spindle. It is claimed for the ring frame that it has an advantage over the mule up to 50's counts, but beyond that the advantage is lost. It is also claimed that its yarn is more regular and stronger; but more twist is put into ring yarn than mule yarn, and this is perhaps the cause of the greater strength. With regard to greater regularity in ring yarn than in mule yarn



(Asa Lees & Co., Ltd.)

Fig. 3.—Plan of Rope Driving for Tin Rollers with Tightening Pulley.

this is impossible if the rollers of both machines are set in due accordance with the length of staple. The position for the rollers is that the distance from the centre of the front roller to the centre of the middle roller should just exceed the length of the staple.

It is claimed that the mule can spin a higher range of counts than the ring frame, which is true. The mule has also a commerical advantage over the ring frame where the yarn has to be packed, because the cost of the ring bobbins on the outward and return journey is saved; but where the ring yarn is sold upon the warp beam, the mule does not possess this particular advantage; with regard, however, to the elasticity of the yarn, the mule is far more effective than the ring frame.

The interest of the cotton spinner in the ring frame exists because of its increasing rivalry with the self-acting mules; it has now practically superseded the flyer-throstle frame so far as cotton spinning is concerned.

It is not yet well known that there are many improvements on the ring-spinning frames as well as on other machines for which extra has to be paid, independent of the ordinary price of the machine. I remember on one occasion having just completed a specification for some weft mules, when a minder, coming into the storeroom, saw the paper and was quite surprised. He thought one had nothing to do but order a number of pairs of mules and get them, and the same with ring frames. This, however, is not the case.

On the driving shaft there is a wheel commonly called the tin-roller wheel or driving wheel. In some cases it is

a double or compound wheel, in order to give a great variation in the turns per inch put in the yarn. This tin-roller wheel drives, by a train of wheels, the front roller of the machine. In this tram of wheels is a double or compound wheel, which is known as the twist wheel; and, by changing this twist wheel for a larger or smaller one, an alteration in the twist per inch is made. A larger twist wheel gives less twist, by speeding the front roller; a smaller twist wheel gives more twist, by retarding the front roller. The speed of the spindle remains unaltered by the changing of counts or of twist per inch.

The front roller then transmits motion to the back and middle rollers in a manner similar to that on mules and fly frames, i.e. a small wheel on the front roller, known as the front roller-pinion wheel, drives a large wheel known as the crown-pinion wheel. On the same stud as the crown wheel is the change-pinion wheel, which goes with, and transmits motion to, the back-roller wheel, which latter is secured on the back roller by a small peg and nut.

On the back roller is a small wheel known as the back roller-pinion wheel which gears with a double or single carrier, this carrier being geared with a wheel on the middle roller, known as the middle roller-pinion wheel. The three lines of drawing rollers on a ring frame occupy a position very different from the drawing rollers of fly frames or mules. The rollers of a ring frame occupy a tilted position. One firm of machinists have adopted an angle of 15 degrees. The distance between the rollers and the thread guides is made very short, with the object of minimizing the breaking of threads.

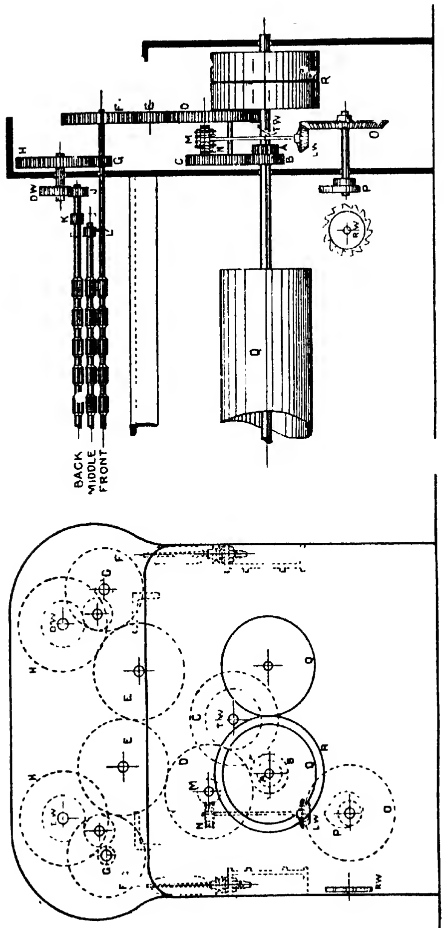


Fig. 4.—Plan of Ring-Spinning Frame Showing Position of Various Wheels.
(Asa Lees & Co., Ltd.)

The thread guide is a curled piece of wire, somewhat similar to the old-fashioned roving eyes on mules. This may be screwed into a V-shaped piece of wood, that is hinged to the thread board; or it may be screwed into a steel

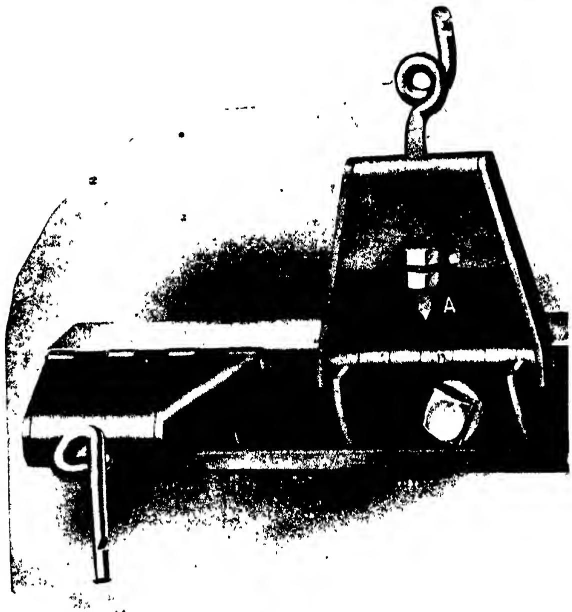


FIG. 5.—Steel Thread Rail with Hardend Wire.
"A" special nut for adjustment of thread guide.

thread rail and locked in position by a nut, which is a great improvement on the old system of wood. The curled wire or thread guide, when fixed in position, should be exactly over the centre of the spindle. The thread guide being over

the centre of the spindle, must be moved out of the way for doffing purposes. The thread board is, therefore, hinged to the roller beam, and arrangements are adopted which turn over the whole of the thread boards on each side of the frame, out of the way of the bobbins, while they are being doffed.

In another arrangement, the thread boards are moved half the distance of the space of the spindles for doffing purposes.

The Ring.

The ring is made of forged steel and is carefully turned and case-hardened. It is carried by, and secured to, a ring rail by a set screw. The ring rail may be made of cast or wrought iron, or it may be made of sheet steel. Some people prefer the ring known as the double ring, so that when one side is worn it can be turned round. The diameter of the ring is reckoned by its inside measurement.

The ring rail is made to rise and fall by lifting mechanism and balance weights, during the process of spinning, so that the yarn is wound on in layers similar to those on the cop of a mule, viz. by a quick, downward motion and a slower, upward movement.

The Traveller.

The traveller of a ring frame is a small piece of steel bent in the form of a letter C, and is connected to the ring by one end of the curl, while the thread as it comes down from the rollers through the guide wire passes through the curl at the opposite end of the traveller, on its way to the bobbin on the spindle. The function of the traveller is

to put twist into the yarn and guide it on to the bobbin. One revolution of the traveller is one twist in the yarn between the spindle and the rollers; and if it were not for the tilted position occupied by the rollers, it would be impossible for the twist to rise to the nip of the rollers, and the consequence would be excessive breakages of the threads.

The speed of the travellers really regulates the twists or turns per inch in ring spinning. The traveller being also a guide for the yarn, not only puts the twist in, but also by its lagging behind the spindle, winds the yarn on the bobbin. If the traveller were a fixed guide and secured to the ring, the revolutions of the spindle would wind on the yarn but it would be without twist, and not only so but a breakage of the yarn would occur, as the spindle would, in the ordinary course of events, wind on a greater length than the rollers would deliver. For instance, a spindle revolving at the rate of 9000 revolutions per minute with a ring bobbin on it of five-eighths of an inch diameter, would wind on 17,671 inches, but the rollers would be delivering only 396·84 inches per minute. Again, if the traveller were secured to the spindle, it would be carried round by the latter, therefore no winding would take place; but every revolution of the traveller would put one twist in the yarn. In this case, breakage of the yarn would soon occur from ballooning, as the twist put in the yarn would be very little indeed in excess of that put in in the ordinary course of events. So that if the traveller were a fixed guide it would be a complete failure; as in the one case we should get all winding and no twisting, and in the other case we should

get all twisting and no winding. But by making the traveller a moveable guide, both operations are performed together, which is an essential feature for the success of the ring frame. The traveller puts the twist in the yarn, and guides it on to the bobbin and causes the yarn to be wound upon the bobbin by its lagging behind the revolutions of the spindle. To be more plain, if a lighter traveller were put on, the yarn would be able to drag it round more easily, and the consequence would be more twist per inch, but less winding and a greater ballooning. Again, in the case of a heavier traveller, the yarn would not be able to drag it round so easily and there would be more tension on the yarn, and, therefore, the ballooning would be less, and would perhaps disappear altogether. The traveller being heavier and the yarn less able to drag it round, its delaying action would be greater, and, therefore, more winding on of the yarn would take place, but less twist; and if the strain were too great by the heavy traveller, breakage of the yarn would soon occur. The twist per inch, put in by a lighter or heavier traveller may appear a serious matter but as will be seen by the calculations, the percentage is very small. A light traveller will cause ballooning, while a heavy traveller will stop it.

Traveller. Clearer.

A small projection known as the traveller clearer is secured to the ring rail by a screw, in such a position that the traveller in its revolutions round the ring just misses coming in contact with it, and in consequence any fibres that adhere to the traveller are caught by it, and the trav-

eller passes on its way freed from these fibres. It is well known that when machines in a cotton mill are working, a good many fine fibres are always flying about, and in the ring room some of them would naturally fall upon the ring and would accumulate and interfere with the traveller by clogging its action.

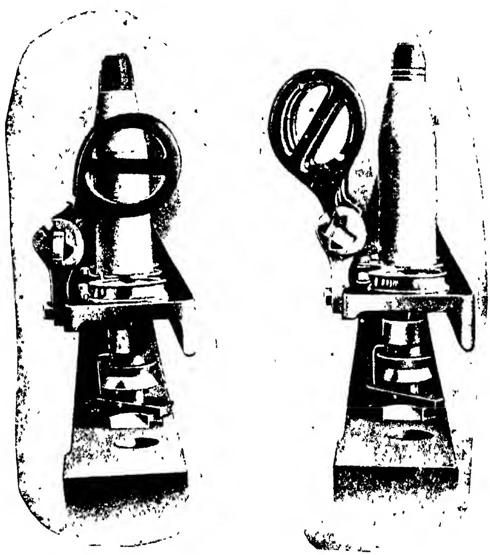
Ballooning.

Ballooning is the bulging or flying outwards of the thread during the operation of spinning. The greater the balloon the less tension there is on the yarn; the smaller the balloon the greater is the tension on the yarn. It is therefore necessary to adopt balloon plates or balloon separators, in order to prevent the threads coming into contact with each other. There is not the same tension on the yarn at all points throughout the building of a set of cops or bobbins. For instance, there is greater tension when winding is taking place at the smallest diameter or nose of the cop. Consequently there must be least tension when winding is taking place at the largest diameter, or the base of the chase. This will be proved from the calculations, or it may be seen at any time by an experienced person who observes the winding at the two points.

By the adoption of the separators shown in the illustration, great speed is obtained with a greater production, since lighter travellers can be used with them than without them.

This is true of all separators, as no traveller will give the same balloon when winding-on the small diameter, as when winding-on the large diameter of the bobbin. It is

also claimed that the separator gives more regular twist, and hence a stronger yarn, and greater length of yarn on the bobbin at each doffing. It is readily thrown back during the operation of doffing, and replaces itself automatically.



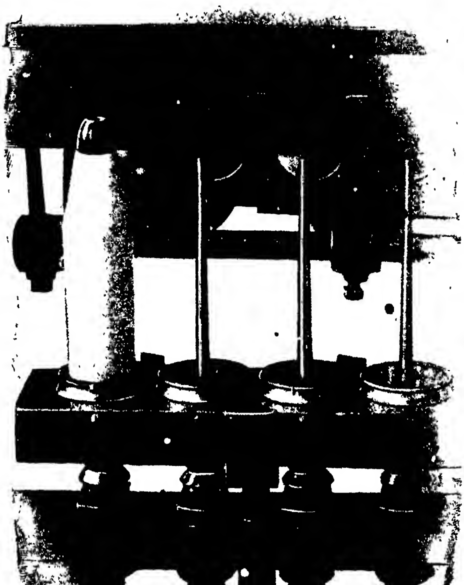
(Brooks & Doxey, Ltd.)

FIG. 6.—Balloon Separators.

In Position. Out of Position.

There is a firm of machinists which claims to be able to make a $1\frac{1}{2}$ inch diameter bobbin in a ring frame of only $2\frac{1}{4}$ inch gauge. In this case the separator (which rises and falls with the lift) is mounted independently of the ring rail

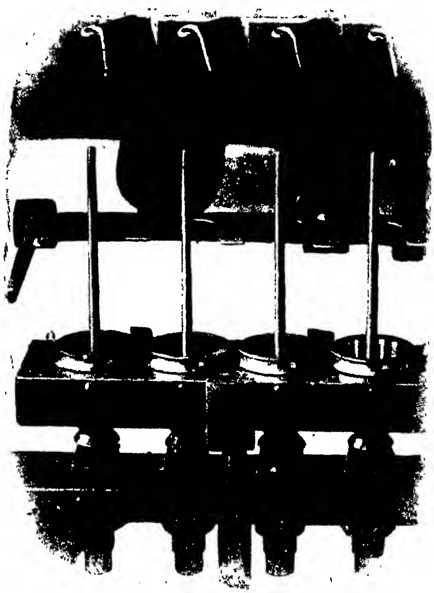
but at the same time receives its motion from the rocking shaft. By applying vertical rods to each of the rocking levers, separate from the ordinary lifting pokers, a suitable



(Brooks & Doxey, Ltd.)
FIG. 7.—Balloon Separators.
Out of Position.

support is provided for a rod that extends the whole length of the frame. To this rod the separators are fixed with set

screws at distances suitable to the gauge of the spindle. The movement of the rocking levers is transmitted to the separators through the vertical rods mentioned, but as the



(Brooks & Doxey, Ltd.)
FIG. 8.—Balloon Separators.
In Position.

point of connexion is nearer the fulcrum than the lifting poker, the stroke is comparatively less. By acting independently of the ring rail, the separators are arranged to work close to the bobbin when the latter is full.

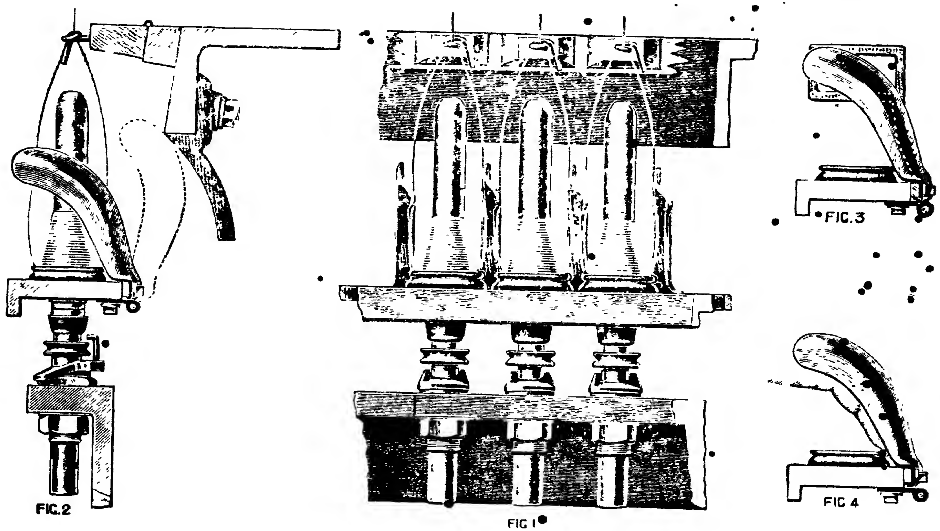


FIG. 9.—" Finger Space " Separator. (Howard & Bullough, Ltd.)

Fig. 1. Working Position. Fig. 2. In Position Showing Section out of Position.
Fig. 3. Contrast Old and New in Position. Fig. 4. In Position: Shield for Finger.

In order to facilitate the doffing arrangements, the rod carrying the separators is connected by levers to the shaft for lifting the thread boards, so that when the latter is turned upon its centre, the whole of the parts move simultaneously. The same firm of machinists supplies, when required, iron fingers in place of the ordinary flap boards, to carry the thread guides. These iron fingers are mounted and capable of swivelling upon a shaft which extends along the front of the frame. Each finger can be lifted independently of its neighbour, as is the case with the ordinary thread board.

When the guides have all to be raised for doffing purposes, the aid of a corresponding number of small projections under each of the fingers is brought into requisition. These projections are secured to the shaft with set-screws and support each finger when in working position. When the shaft is turned upon its centre by the operative, the projections turn with it and each one moves the finger it is supporting, and by so doing the thread guides are moved out of the way for doffing purposes.

The New Patent "Finger-Space" Separator.

As is well known the application of separators for individually separating the threads to prevent them from interlashing into each other during the ring-spinning process has become almost universal.

As manufacturers of ring-spinning frames, Messrs. Howard & Bullough, Ltd., are accredited with having more separators in operation than any other machinist in the trade, and we are enabled to support this assertion by their

statement that under a prior patent, by the same inventor, over seven million separators were made during the life of such patent, and several millions have been made since.

By this fact alone they have gained a most extensive experience in this particular branch, and it has led them to the opinion that if it were possible to devise a separator which would give greater fingering facility for piecing and doffing than hitherto, whilst retaining the other useful qualities of a separator, in relieving the yarn of strain at the nip of the leather-covered delivering rollers, giving more compression to the winding, and admitting of a maximum number of spindles in a minimum amount of space, a most desirable object would be attained.

At the same time the high anti-ballooning efficiency of the finger-space separator consists in the fact that any two adjacent separators act on the ballooning at a different part, in that the one separator operates on the upper portion of the balloon and the next separator operates on the lower portion of the same balloon, whereas in the old type any two separators operated on one and the same part of the balloon, thus showing that the finger-space separator is twice as effective in anti-ballooning as the old type; and being manufactured from highly polished steel, and electro-plated, is of neat appearance, with less than half the usual weight for the ring rail to operate.

What is most important in this separator in comparison with others, is that it provides more finger room. The maximum amount of space is obtained for the lower portion of the separator on its convex side, so that it can practically be almost touching the full bobbin and therefore

obviously making the remaining space on the concave side available as finger room. Furthermore, this separator forms a guide and guard for the knuckles of the finger, and thus prevents the operator from breaking down the end of the bobbin adjacent to that which is being attended to.

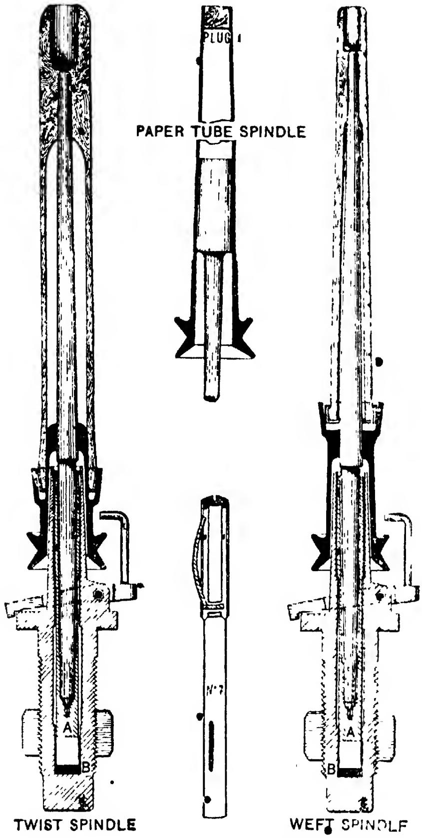
This new device therefore fully deserves the appellation of a free-fingering separator without the loss of any of the advantages appertaining to any separator hitherto invented, and it only needs to be seen in operation to confirm all that has been said for it.

The makers are so assured of the advantages of this finger space separator that they are prepared to offer to supply a complete set for a ring frame, which if not satisfactory after a month's trial they will take back, without expense to the spinner; and, notwithstanding the success of their old type of separator, they are so confident in the surpassing qualities of the finger-space separator that they are willing to replenish their customer's frame with a set of the new type on approval.

We may also add that British and foreign patents have been taken out for the finger-space separator in the principal cotton-spinning countries.

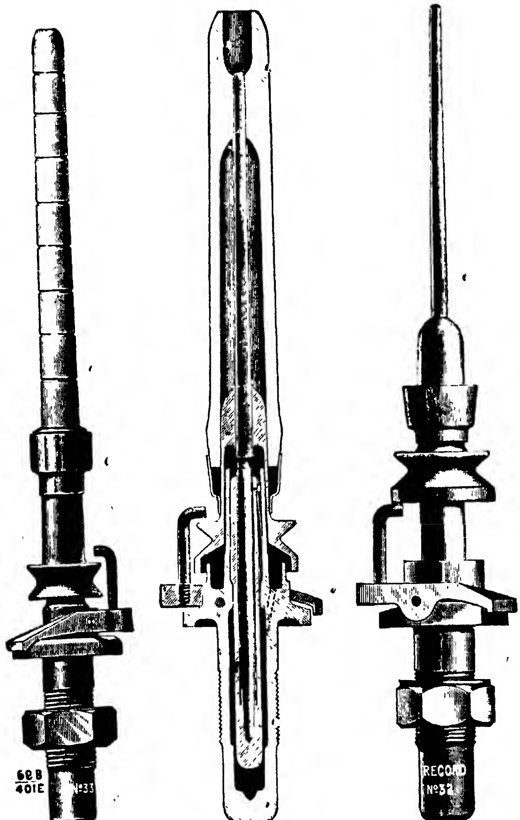
The Spindles.

The spindles of a ring frame are examples of accurate workmanship, and few things connected with cotton-spinning machinery have more fully occupied the attention of inventors and machinists than the construction of the ring-frame spindles and the bearings in which they work; for, however well a spindle is made with regard to both



(Brooks & Doxey, Ltd.)

Fig. 10.



(Howard Bullough, Ltd.)

Weft Spindle. Twist Spindles.

Fig. 11.

quality of steel and finish, it cannot be expected to last long, or to produce good results, if the arrangements for lubrication are defective and the spindle-bearing is not well protected from dirt and grit.

LUBRICATION.

Different methods have been adopted by various machinists for supplying the lubricant to these spindles. In one arrangement the oil cup can be readily detached for cleaning and refilling purposes, and when it is replaced the reservoir containing the oil is well shielded from the fluffy cotton which is always flying about the spinning machines.

In order to apply the cup, the bolster is prolonged some distance below the end of the spindle and its bearings, and its lower portion is hollow and open at the bottom. The cup is made in the form of a tube with a closed end, the exterior diameter corresponding with the inside diameter of the bolster, and it is turned so as to slide freely therein. When the cup has been refilled with oil it is passed up into the lower end of the bolster and secured thereto by a bayonet joint; the oil then surrounds the lower end of the spindle-bearing and lubricates both it and the spindle.

When the spindle is at work, the provision made to guide the oil in its proper course prevents any portion of oil flying out radially at that point of the spindle where the flange of the wharve overlaps the hollow part of the bolster.

In another method lubrication can be applied while the spindle is in motion. The spindle receives its supply in a recess just below the wharve which is provided with an oil socket which is put into the pedestal at the top and

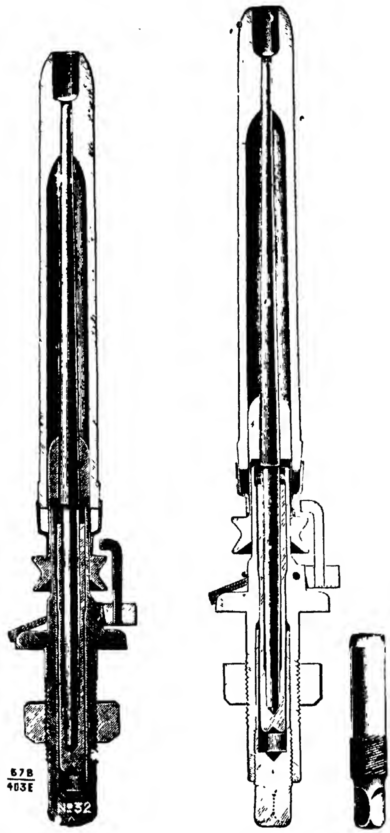


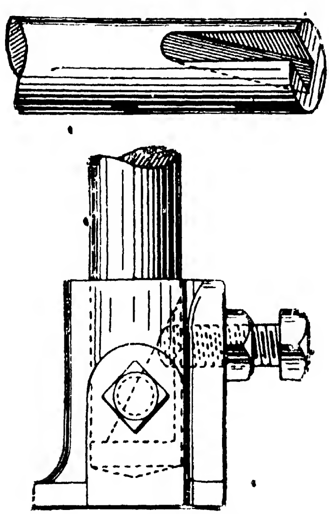
Fig. 12.—Section of Twist Spindles Showing Oil Cup.

fits into the same with a taper. The socket can be removed for cleaning out, leaving the pedestal fixed in the rail in its original position centrally to its spinning ring, and as set by the frame erector. This spindle is provided with a neat holding-down catch, which is arranged so that, with the thumb in front and the forefinger at the back, the catch may be lifted and the spindle grasped and raised out of its socket by one hand only.

In another method of applying the lubricator, a boss is formed, having a rectangular projection at one side. Within this boss is an annular groove, and running through its base is a series of small holes through which communication is established with the oil space formed in the bolster. When the spindle is working, its sleeve covers the top of the annular groove, but when it is desired to introduce a fresh supply of oil the spindle is raised a little without removing the spindle band from the wharve. The oil is then poured into the groove and finds its way through the holes in the base of the groove to the oil space in the bolster. A slight tapping of the spindle holder is sufficient to release the spindle and allow it to fall into working position again. The revolving action of the spindle causes the oil to circulate from the lower cavity part of the bolster, well up and in close contact with the spindle blade, over the top of the edge of the inner bush, returning again to the well along the inner surface of the bolster. The upper part of the bolster is made of a suitable height to prevent the overflowing of the oil down the outer surface.

THE POKERS.

The pokers are long rods upon which the ring rail is secured and carried; their lower ends are connected with the rocking shaft, and the ring rails rest upon them at intervals along the frame. The pokers glide vertically in bushes fixed in the spindle rail; their lower ends being connected by the levers to the rocking shaft, in order to give the upward motion to the ring rail and to allow the balance weights to return it to its initial position for the succeeding layer. The method of operating the pokers on the ring rail so as to give a reciprocating motion for building the cop, is very simple, and in most modern ring frames there is a similarity of construction. The principal mechanism employed consists of a cam, actuating a lever, on the end of which is attached a chain leading to levers that act upon the lower ends of the pokers. The speed of the cam is regulated to give such a motion to the ring rail as may be suitable to the counts



(Howard Bullough, Ltd.)
FIG. 13.—Adjustable Poker Foot.

which are being spun; and any alteration in the speed of the front roller consequent upon a change of the counts also causes a similar alteration in the speed of the cam.

The cam is so shaped as to give an upward motion to the ring rail slower than the downward motion, and by this action is obtained the binding thread on a ring frame similar to that on a mule. If it were not for the binding thread, either on mule or ring frame, the yarn would easily rub off, and would also wind off very irregularly.

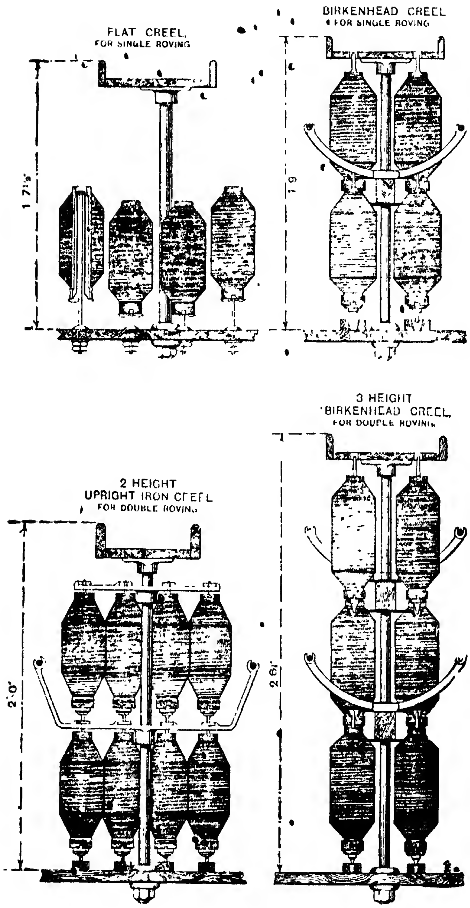
At the completion of each layer or lift, the new layer is started higher up the bobbin, consequent upon the action of the tumbler catch which forces round the ratchet wheel and so turns the bowl which winds on a portion of the chain; and this action of the tumbler continues throughout the building of a set of bobbins or cops. By careful adjustment of a set-screw, the number of teeth which the tumbler catch must move at each lift can be regulated.

The ring rail is not lowered by the action of the pokers and the levers that operate the latter, it being only the lifting of the rail that is operated by the pokers. The lowering of the rail is effected by its own weight, together with a series of balance weights arranged for that purpose.

The rocking shafts that operate the pokers are connected by strong coupling rods, so that each poker is firm and the action on the whole is simultaneous.

Weighting of Rollers.

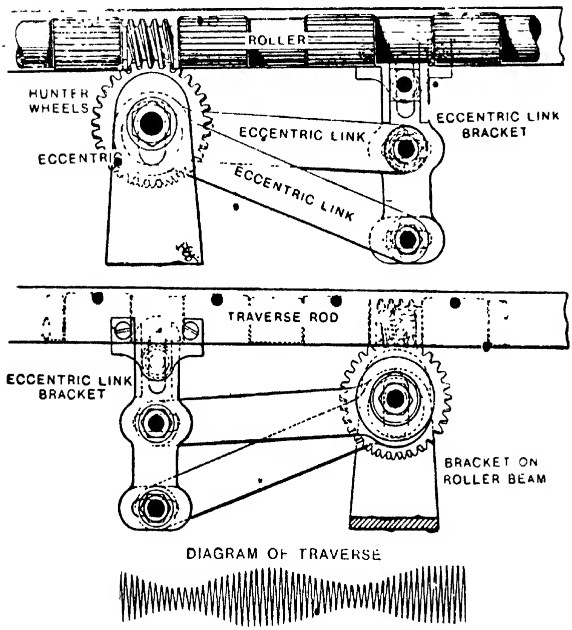
There are two systems of weighting on a ring frame, lever weighting and dead weighting. Lever weighting is very similar to that used in mule-spinning. In the dead-weight



(Brooks & Doxey, Ltd.)

FIG. 14.—Creels for Single and Double Rovings.

method, the weight hangs from a hook or saddle placed over the middle of the front leather-covered rollers, but instead of a separate weight for each hook or saddle, as on a mule, the weight is made twice the size and long enough to go



(Brooks & Doxey, Ltd.)
FIG. 15.—Roller Traverse Motion.

cross the frame, so that the other end hangs from the front leather-covered roller on the other side of the frame.

On account of the ease with which the operatives can be

taught to work on the ring frame, and the comparatively small skill required by the overlooker to keep it in order, the ring-spinning frame has certainly made very rapid strides both in this and foreign countries. One great objection to the ring frame, viz. its inability to spin on the bare spindle has been overcome; but to be a commercial success, it must have a production equal to a ring frame using bobbins and must build up as compact a cop as the mule, and one that can be as easily prepared for the market.

For the successful working of any machine four things are necessary: good material, good lubrication, cleanliness, and attention on the part of the operative.

In conclusion, this brief description will enable the student to grasp the various details of the machine, and thereby be able to understand the following calculations:—

PARTICULARS OR FORMULA OF A RING FRAME.

Tin-roller wheel	35 teeth
Large compound wheel	120 ,,
Small compound wheel (or twist)	44 ,,
Front-roller wheel	80 ,,
Tin-roller diameter	10 inches
Spindle-wharve diameter	$\frac{7}{8}$,,
Front roller-pinion wheel	18 teeth
Crown-pinion wheel	120 ,,
Change-pinion wheel	40 ,,
Back-roller wheel	50 ,,
Back roller-pinion wheel (driving carrier)	21 ,,
Middle roller-pinion wheel (driven by carrier)	16 ,,
Diameter of front roller	1 inch
Diameter of back roller	1 ,,
Diameter of middle roller	$\frac{7}{8}$,,
Ratchet or builder wheel	40 teeth
Counts or hank being spun	32's
Counts of roving used	4's

CALCULATIONS.

Rule 1.

To find the counts or hank of yarn when wrapping. For a dividend take as many 100's as you have yards and divide by 12, and use the product for the dividend. For a divisor take the weight in grains. Proceed as in simple division. The answer will be the counts of yarn.

Example.

If 120 yards or 1 lea of yarn weigh 31 grains, what are the counts?

$$\frac{120 \times 100}{12 \times 31} = 32 \text{ counts.}$$

Remarks.—This rule applies to any length of yarn.

For instance, if 80 yards of yarn weighed 24 grains, then

$$\frac{100 \times 80}{12 \times 24} = 27{\cdot}77 \text{ counts.}$$

Rule 2.

To find a change-pinion wheel when changing from one hank to another. For a dividend multiply the existing hank by change wheel on. For a divisor take the required hank. The answer will be the change wheel required.

Example.

If a ring frame is spinning 32's with a 40 change-pinion wheel on, find wheel required to spin 50's.

$$\frac{32 \times 40}{50} = 25{\cdot}6 \text{ wheel required.}$$

This rule is very simple and at the same time the commonest rule of a cotton mill.

Rule 3.

To find a change-pinion wheel when the hank roving is to be changed. For a dividend multiply the counts being spun by the hank roving to be supplied, and by the change-pinion wheel now on.

For a divisor multiply the hank required to be spun by the hank roving now being supplied. The answer will be the change-pinion wheel required.

Example.

If a ring frame is spinning 32's from a 4-hank roving and with a 40 change-pinion wheel, and is required to change to 46's from a 5-hank roving, find required change pinion.

$$\frac{32 \times 5 \times 40}{46 \times 4} = 34 \cdot 78 \text{ or say } 35 \text{ wheel required.}$$

This rule is not often required, as it does not pay in cotton spinning to be continually changing the hank of roving.

Rule 4.

To find a change pinion, to produce the same hank when the front roller-pinion wheel is changed. For a dividend multiply front-roller wheel on, by the change-pinion wheel on. For a divisor take front-roller pinion to be put on or geared. The answer will be the wheel required.

Example.

If a ring frame is working with an 18 front-roller pinion and a 40 change pinion, and you wish to change the 18 for

a 21, find change pinion required without changing the counts.

$$\frac{18 \times 40}{21} = 34.$$

This rule is very useful when one has not a very plentiful supply of change pinions. For instance it might be necessary to put another frame on 32's, while there are no more spare 40-pinions, but if the front-roller pinion is a double one of 18-21 teeth by gearing with the 21, 32's could be spun with a 34-pinion wheel.

Again if the gearing be 18 and the teeth either break or become badly worn, the 21 gear can be used and the stopping of the machine for the purpose of putting on a new pinion wheel avoided.

Rule 5.

To find a change-pinion wheel, when you change the back-roller wheel, and to produce the same hank. For a dividend multiply the back-roller wheel to be put on by the change wheel you have on. For a divisor take the back-roller wheel on. The answer will be the wheel required.

Example.

If a ring frame is spinning 32's with a 40-pinion and a 50-back roller, and you wish to change the 50 for a 45 back-roller wheel, find change pinion required.

$$\frac{45 \times 40}{50} = 36 \text{ wheel required.}$$

This is a useful rule when there is a shortage of pinion wheels. It enables the operator to spin the same counts

on one ring frame as on another, though the same wheel is not available.

Rule 6.

To find a change-pinion wheel to produce the same hank when the crown wheel is to be changed., For a dividend multiply the crown wheel to be put on by the change-pinion wheel now on. For a divisor take crown wheel now on. The answer will be the wheel required.

Example.

If a ring frame is spinning 32's with a 40 change pinion and a 120 crown wheel, and it is desired to change the 120 crown wheel for a 110 crown wheel, find change pinion required.

$$\frac{40 \times 110}{120} = 36{\cdot}66 \text{ wheel required.}$$

This is a very useful rule but not often needed. For instance, it will be found useful in cases where teeth get badly worn or broken, and there is no wheel of the same number of teeth, but one of a different number; the use of the rule will save stopping the machine until a wheel can be obtained from the machinist. It is also useful in extreme changes. For instance, a certain quantity of very coarse yarn might be wanted, so coarse that no pinion is large enough, but a smaller crown wheel will assist in spinning the counts required.

First find pinion required, to spin the present counts and then proceed as per Rule 2, to find the required pinion for the required counts.

Rule 7.

To find the draft in the rollers of a ring frame or total draft. For a dividend multiply the number of teeth in crown wheel by number of teeth in back-roller wheel and by the diameter of the front roller. (In all the following calculations where diameters are mentioned these are taken in inches) For a divisor, multiply the number of teeth in the front-roller pinion by the number of teeth in the change pinion and by the diameter of the back roller. The answer will be the total draft.

Note.—If the front and back rollers are of the same diameter, they may be left out of the calculation. If not the same diameter, they must be reduced to $\frac{1}{8}$th of an inch.

For instance $\frac{3}{4}$ths would be $\frac{6}{8}$ths, and multiply by 6. For $\frac{7}{8}$ths by 7; but for 1 inch multiply by 8.

Example.

On a ring frame the crown wheel contains 110 teeth, the back-roller wheel 50 teeth, and the front-roller pinion 18 teeth the change pinion 40 teeth, and the front roller is 1 inch in diameter and back roller $\frac{7}{8}$ths inch in diameter. Find total draft.

$$\frac{110 \times 50 \times 8}{18 \times 40 \times 7} = 8{\cdot}7 \text{ total draft.}$$

This will be found to be a very useful rule in all cotton-spinning machines.

Example.

On a ring frame the crown wheel contains 120 teeth, the back-roller wheel 50 teeth, and the front pinion 18

teeth, the change pinion 40, and the front and back rollers are 1 inch in diameter. Find total draft.

$$\frac{120 \times 50}{18 \times 40} = 8 \cdot 3$$

Rule 8.

To find a draft wheel or change wheel. For a dividend multiply the number of teeth in the crown wheel by the number of teeth in the back-roller wheel and by the diameter of the front roller. For a divisor multiply the number of teeth in the front-roller pinion by the draft required and by the diameter of back roller. The answer will be the draft or change wheel.

Example.

If on a ring frame the crown wheel contains 120 teeth, the back-roller wheel 50 teeth, and the front roller-pinion wheel 18 teeth, and the draft required is 8·3, the front and back rollers being 1 inch in diameter, find change pinion required.

$$\frac{120 \times 50}{18 \times 8 \cdot 3} = 40 \text{ wheel required.}$$

Note.—If the draft is left out of this rule, a constant number is obtained which, if divided by the draft, will give the draft wheel required and vice versa.

Example.

$$\frac{120 \times 50}{18} = 333 \cdot 3 \text{ constant number.}$$

From the constant number find change wheel to give 8·3 draft.

$$333 \cdot 3 \div 8 \cdot 3 = 40 \text{ change wheel.}$$

These rules on draft will be found to be very useful, as good spinning and a good quality of yarn depend to a certain extent upon the draft. That is, no matter how good the quality of the material supplied, it is certain to lose some of its qualities if overdrafted; although it is not possible to fix a rule by which we can say that any yarn spun with more than say 9 of a draft, has been ruined or spoiled in the process.

The finer the fibres of the cotton used, the longer will be the staple and the draft may be greater. On the contrary, the coarser the fibres of the cotton used, the shorter will be the staple and, therefore, the draft must be less. At the same time the shorter the fibres of the cotton used, the closer must the rollers be set, and vice versa.

This statement is true in every detail, but though true, I have known many that have been misled by it. I have met not only operators but officials who did not know what draft was. Their idea of draft was, that if there were ⅛th of an inch of space between the front and middle rollers there was ⅛th of draft in the roller. Some of these were officials of many years' standing.

If such were the case, and one were spinning 32's from a 4-hank roving, and from Rule 7 one found a total draft of 8·73 on changing to say 16's from the same hank roving, one would find from the same rule about 4·36 of a draft, which would from their theory be incorrect, because it would not be necessary to open or close the rollers. Hence arises the plain question, What is the draft as it is known in cotton-spinning machinery? The draft in any cotton-spinning machine is determined by the proportion

in fineness between the material received and the material delivered.

Take the ring-spinning frame for an example; this receives its roving at 4 hanks to the pound, and delivers its yarn at 32 hanks to the pound.

$$32 \div 4 = 8 \text{ of a draft.}$$

It is not, however, the case that a 4-hank roving is a correct 4 hank as stated; generally $\frac{1}{8}$th of a hank on the coarse side is allowed for loss in the rollers, etc.

Again, although the draft in the roller is the number of times it delivers its material finer than it receives it, it may also be explained as follows: it is the proportion between the front-roller revolutions and those of the back roller. For instance, while the back roller revolves once the front roller must revolve over $8\frac{1}{4}$ times, if there is a draft of 8·3, when both are of one diameter.

When the back and front rollers are not of the same diameter, draft may be summed up as follows: it is the number of times that the surface speed of the front roller exceeds that of the back roller. This last explanation will apply to any machine, by using feed and delivery terms in the place of rollers.

Rule 9.

To find a ratchet, builder, or star wheel when changing from one hank to another. For a dividend multiply square root of hank required by the wheel now on. For a divisor take square root of present hank. The answer will be the wheel required.

Example.

If a ring frame is spinning 32's with a 40 ratchet wheel and you are required to change it to 40's, find ratchet wheel required.

Square root of 32's is 5·66.

Square root of 40's is 6·32.

$$\frac{6{\cdot}32 \times 40}{5{\cdot}66} = 44 \text{ wheel required.}$$

This rule is a useful one and is required for every change of counts.

There is a difference of opinion whether the rule should be worked by square root or by simple proportion. Some work it one way and some the other, and then correct the wheel after the first doffing, if it is not to their liking. Those who favour the method by proportion generally put as many teeth on the ratchet wheel as they take off the pinion, when changing from one hank to another.

Rule 10.

To find the twist (or turns per inch) in the yarn. For a dividend multiply the number of teeth in the front-roller wheel by the number of teeth in the large compound wheel and by the diameter of the tin roller. For a divisor multiply the number of teeth in the small compound wheel by the number of teeth in the driving wheel on the driving shaft, and by the diameter of the spindle wharve, and by the circumference of front roller.

Example.

If on a ring frame the driving or tin-roller wheel contains 35 teeth, the large compound wheel 120 teeth, the small

compound wheel (or twist wheel) 44 teeth, and the front-roller wheel 80 teeth; the front roller 1 inch diameter, which is 3·1416 in circumference, the tin roller 10 inches in diameter, and the spindle wharve $\frac{7}{8}$th inch in diameter; find turns per inch.

$$\text{Ex.}\ \frac{80 \times 120 \times 10 \times 8}{35 \times 44 \times 3{\cdot}1416 \times 7} = 22{\cdot}67$$

Divisor.	Dividend.
$35 \times 44 \times 7 \times 3{\cdot}1416$	$80 \times 120 \times 10 \times 8$

This rule is necessary in ring spinning, as to a certain extent the strength of the yarn depends upon the turns per inch.

This general method of ascertaining the twist is not exact (although near enough for practical purposes), because the traveller does not revolve quite so quickly as the spindle, or, as explained before, there would be no winding; to put it more plainly, for every revolution lost by traveller one turn or one twist is lost, and supposing it were winding on the large diameter of $1\frac{1}{4}$ inches, the circumference would be 3·9270, or close upon 4 inches, so that one twist would be lost in about 4 inches, and if winding on the small diameter of $\frac{5}{8}$th inch, the circumference would be 1·9635, or say 2 inches, so that in the latter case it would lose $\frac{1}{2}$ turn per inch, and in the former $\frac{1}{4}$ turn per inch, the percentage of which is very small.

Rule 11.

To find the turns of the spindle for one turn (or revolution) of the front roller. For a dividend multiply the number of teeth in the front-roller wheel by the number of teeth in the large compound wheel, and by the diameter of the front roller. For a divisor multiply the number of teeth in the small compound wheel by the number of teeth in the driving wheel and by the diameter of the spindle wharve. The answer will be the turns of the spindle to one of the front roller.

Example.

On a ring frame the driving wheel contains 35 teeth, the large compound wheel 120 teeth, the small compound 44 teeth, and the front-roller wheel 80 teeth, the tin roller is 10 inches diameter and the spindle wharve is $\frac{7}{8}$th inch diameter. Find number of turns of the spindle for one turn of the front roller.

$$\frac{80 \times 120 \times 10 \times 8}{35 \times 44 \times 7} = 71{\cdot}24 \text{ turns.}$$

This is a useful rule but one not often required. It is used when making out specifications.

Rule 12.

To find a constant number for twist. For a dividend multiply the number of teeth in the front-roller wheel by number of teeth in the large compound wheel and by the diameter of the tin roller. For a divisor multiply the number of teeth in the driving wheel by the diameter of the spindle wharve and by the circumference of the front

roller. The answer will be the constant number for twist, which, if divided by the turns required, will give the twist wheel required.

Example.

On a ring frame the driving wheel contains 35, the large compound wheel 120, the small compound wheel 44, the front-roller wheel 80 teeth, the tin roller is 10 inches diameter and the spindle wharve $\frac{7}{8}$th inch diameter and circumference of front roller 3·1416 inches. Find constant number.

$$\frac{80 \times 120 \times 10 \times 8}{(3{\cdot}1416 \times 35 \times 7 = 769{\cdot}6920)} = 997{\cdot}8 \text{ constant number.}$$

This will be found a very useful rule, and many prefer to work from it the required twist wheels and make out a sort of ready reckoner for reference.

Rule 13.

To find a twist wheel from the constant number. For dividend take the constant number; for a divisor take turns per inch required. The answer will be the wheel required.

Example.

If a ring-frame twist constant number be 997·8, find twist wheel to give 22·67 turns per inch.

$$997{\cdot}8 \div 22{\cdot}67 = 44 \text{ wheel required.}$$

Rule 14.

To find a twist wheel without using the constant number. For a dividend multiply the number of teeth in the front-roller wheel by the number of teeth in the large compound

wheel, and by the diameter of the tin roller. For a divisor multiply the number of teeth in the driving wheel by the turns per inch required, by the diameter of the spindle wharve and by the circumference of front roller. The answer will be the twist wheel required.

Example.

On a ring frame the driving wheel contains 35 teeth, the large compound wheel 120 teeth, and the front-roller wheel 80 teeth, the tin roller is 10 inches diameter, the spindle wharve $\frac{7}{8}$th inch diameter, and the circumference of the front roller 3·1416 inches. The turns per inch required are 22·67. Find twist wheel to give those turns per inch.

3·1416	80
35	120
157080	9600
94248	10
109·9560	96000
7	8
769·6920	768000
22·67	
53878440	
46181520	
15393840	
15393840	
17448·917640	

```
17448·91) 768000·00 (44 wheel required.
          6979564
          -------
           7004360
          6979564
          -------
             24796
```

This rule gives a check against the two previous rules, and it is as well to be able to prove the calculations before putting them into practice.

Rule 15.

To find a twist wheel in changing from one hank to another without using the constant number. For a dividend multiply the square root of the hank now being spun by the twist wheel on. For a divisor take square root of hank required. The answer will be the twist wheel required.

Example.

A ring frame is spinning 32's with a 44 twist wheel, and it is required to change it to 40's.

Find twist wheel required.

Square root of 32 is 5·66.
Square root of 40 is 6·32.

```
        5·66
          44
        ----
        2264
       2264
      ------
6·32) 249·04 (39 wheel required.
       1896
       ----
       5944
       5688
       ----
        256
```

This rule is commonly used when changing from one hank to another. Some, however, prefer to make a ready reckoner, and when changing to refer to the turns per inch; opposite the turns should be the twist wheel to give those turns.

Rule 16.

To find the revolutions of front roller per minute. For a dividend multiply the revolutions of the driving shaft by the number of teeth in the driving wheel and by the number of teeth in the small compound wheel. For a divisor multiply the number of teeth in the large compound wheel by the number of teeth in the front-roller wheel. The answer will be the revolutions of front roller per minute.

Example.

On a ring frame the driving shaft is making 787·5 revolutions per minute, the driving wheel contains 35 teeth, the small compound wheel 44, the large compound wheel 120, and the front-roller wheel 80 teeth. Find revolutions of front roller per minute.

80	787·5
120	35
9600	39375
Divisor	23625
	27562·5
	44
	1102500
	1102500
	12127500

9600) 12127500 (126·32 revolutions of front roller.
9600
25275
19200
60750
57600
31500
28800
27000
19200
7800

This rule is necessary, because the person in charge of the machines should know at what speed the front roller is working.

Rule 17.

To find revolutions of the spindle per minute. For a dividend multiply the number of revolutions of the tin roller per minute by diameter of the tin roller in inches. For a divisor take diameter of the spindle wharve. The answer will be the revolutions of the spindle per minute.

Example.

If on a ring frame the driving shaft is making 787·5 revolutions per minute, the diameter of the tin roller being 10 inches and diameter of spindle wharve $\frac{7}{8}$th inch. Find revolution of spindles per minute.

```
   787·5
      10
  ------
  7875·0
       8
  ------
7) 63000·0
  ------
  9000·0 revolutions per minute.
```

This rule is necessary in cotton spinning, as the person in charge should know at what speed the spindles are revolving.

Rule 18.

To find production in hanks or pounds per spindle. For a dividend multiply revolutions of front roller per minute by the circumference in inches and by the number of minutes worked, allowing 10 per cent for stoppages. For a divisor take 36, that being the number of inches in one yard, and 840 the number of yards in a hank. The answer will be the number of hanks per spindle. This, if divided by the counts, will give the weight per spindle.

Example.

If the front roller of a ring frame is making 126·32 revolutions per minute and is 1 inch in diameter, working 55 hours per week. Find production in hanks and lbs. allowing 10 per cent for stoppages.

3·1416
126·32

62832
94248
188496
62832
31416

396·846912
60

23810·814720
55

119054073600
119054073600

1309594·809600
90

100) 117863532·864000

12) 117863532864

3) 98219·61072

840) 32739·87024 (38·97 hanks per spindle.
2520

7539
6720

8198
7560

6387
5880

507

Hanks per spindle divided by the counts, will give lbs. per spindle.

$$38{\cdot}97 \div 32\text{'s} = 1{\cdot}21 \text{ lbs. per spindle.}$$

This rule is necessary, as an overlooker may be called upon to state whether he can spin a certain number of lbs. of a given counts in a certain time, or by a given day, and unless he be acquainted with the amount his machines are capable of producing he cannot answer the question; he may guess, but guessing is very risky at times, because if the order is not completed in a given time it might be cancelled and his firm would have a certain amount of yarn left on hand until another customer was found for it. And again the firm would lose the confidence of the customer and might also lose his custom.

Rule 19.

To find the number of inches delivered per minute by the front roller of a ring frame. Take the number of revolutions of the front roller and multiply it by the circumference in inches. The answer will be the number of inches delivered per minute.

Example.

The front roller of a ring frame is making 126·32 revolutions per minute and is one inch in diameter. Find number of inches delivered per minute.

A roller of 1 inch in diameter is 3·1416 inches in circumference.

$$126{\cdot}32 \times 3{\cdot}1416 = 396{\cdot}846912 \text{ inches delivered.}$$

This rule is in one sense a scale of production, as will be seen from the previous rule.

Rule 20.

To find the turns per minute lost by a traveller in winding on at the smallest diameter on the cop chase or empty bobbin. For a dividend take number of inches delivered per minute. For a divisor take circumference of empty bobbin. The answer will be the number of turns or revolutions lost by traveller per minute.

Example.

If on a ring frame the front roller is delivering 396·84 inches per minute, and the diameter of the cop nose or empty bobbin is ⅝th inch, find turns lost by traveller. (⅝th inch diameter equals 1·9635 inches in circumference.)

$$396{\cdot}84 \div 1{\cdot}9635 = 202 \text{ revolutions lost.}$$

Rule 21.

To find the turns per minute lost by traveller in winding on at the base of the chase of a full bobbin. For a dividend take the number of inches delivered per minute. For a divisor take circumference of full bobbin. The answer will be the turns or revolutions lost by traveller per minute.

Example.

If on a ring frame the front roller is delivering 396·84 inches per minute and the diameter of the full cop or bobbin is 1¼ inches, find turns lost by traveller. (1¼ inches diameter equals 3·9270 inches in circumference.)

$$396{\cdot}84 \div 3{\cdot}9270 = 101 \text{ revolutions lost.}$$

Rule 22.

To find revolutions of traveller per minute when winding on at the nose of the cop or empty bobbin. For a dividend take the number of revolutions of the spindle per minute. Subtract from it the turns per minute lost by traveller when winding on the empty bobbin. The answer will be the revolutions of traveller per minute.

Example.

A ring-frame spindle is making 9000 revolutions per minute and the traveller when winding on at the cop nose or empty bobbin loses 202 revolutions per minute. Find revolutions of the traveller.

9000 − 202 = 8798 revolutions of traveller.

Rule 23.

To find revolutions of traveller per minute when winding on at the base of the cop chase or full bobbin. For a dividend take number of revolutions of the spindle per minute. Subtract from it the turns per minute lost by traveller when winding on the full bobbin. The answer will be the revolutions of traveller per minute.

Example.

A ring-frame spindle is making 9000 revolutions per minute and the traveller when winding on at the base of the chase loses 101 revolutions per minute. Find revolutions of traveller.

9000 − 101 = 8899 revolutions of traveller.

Rule 24.

To find the turns per inch put in the yarn on an empty bobbin. For a dividend take the revolutions of traveller per minute on an empty bobbin. For a divisor take number of inches delivered per minute by the front roller. The answer will be the turns per inch.

Example.

A ring-frame traveller is making 8798 revolutions per minute on an empty bobbin, and the front roller is delivering 396·84 inches per minute. Find turns per inch.

$$8798 \div 396{\cdot}84 = 22{\cdot}17.$$

Rule 25.

To find the turns per inch put in the yarn on a full bobbin. For a dividend take the revolutions of traveller per minute on a full bobbin. For a divisor take number of inches delivered per minute by the front roller. The answer will be the turns per inch put in the yarn on a full bobbin.

Example.

On a ring frame the traveller is making 8899 revolutions per minute when winding on the full bobbin, and the front roller is delivering 396·84 inches per minute. Find turns per inch.

$$8899 \div 396{\cdot}84 = 22{\cdot}42 \text{ turns per inch.}$$

Rule 26.

To find the percentage of difference in twist per inch between empty and full bobbins. For a dividend subtract

the turns per inch on the empty bobbin from the turns per inch on the full bobbin, and multiply by 100. For a divisor take twist per inch on the empty bobbin. The answer will be the percentage of difference of twist per inch between empty and full bobbins.

Example.

A ring frame is putting 22·17 turns per inch in the yarn on the empty bobbin, and 22·42 turns per inch in the yarn on a full bobbin. Find percentage of difference.

$$22{\cdot}42 - 22{\cdot}17 = {\cdot}25 \times 100 \div 22{\cdot}17 = 1{\cdot}1 \text{ per cent.}$$

These rules not only show that there is a difference in the twist per inch put in ring yarn, but also that the difference is very small, so small that it is almost impossible to detect it in actual practice.

Rule 10 shows that by the ordinary way of finding the turns per inch 22·67 is attained simply because of the use of the revolutions of spindle instead of traveller. It is first necessary to ascertain the revolutions of spindle in order to find revolutions of traveller, and both being very near to each other, the spindles are generally taken.

It might be asked, why does the traveller lag behind the spindle speed at all? The answer is because, in the first place, of the friction between it and the ring. And in the second place, if the traveller were so light as to be dragged round by the yarn at the same speed as the spindle, there would be no winding on of yarn. Therefore, in order to cause winding on to take place, the traveller must lag behind the speed of the spindle For an example we

will take the turns per inch by Rule 10 and the average turns per inch between full and empty bobbins.

$22{\cdot}42 + 22{\cdot}17 = 44{\cdot}59 \div 2 = 22{\cdot}29$ average.

$22{\cdot}67 - 22{\cdot}29 = {\cdot}38 \times 100 \div 22{\cdot}29 = 1{\cdot}70$ per cent.

From this last example it will be seen that the percentage of difference is very small, being only 1·70, which means a loss of $1\frac{3}{4}$ turns out of every 100 turns put in the yarn, or in other words, instead of the traveller putting 100 turns in the yarn, it puts $98\frac{1}{4}$, and as one finds the percentage so small, it may be ignored in actual practice.

Rule 27.

To find the draft between the front and middle rollers of a ring frame. For a dividend multiply the number of teeth in the crown wheel by the number of teeth in the back-roller wheel, by the wheel on middle roller and by the diameter of front roller. For a divisor multiply the number of teeth in the front-roller pinion by the number of teeth in the change pinion, by the wheel on back roller (known as the back-roller pinion) and by the diameter of the middle roller. The answer will be the draft between the front and middle rollers.

Example.

On a ring frame the crown wheel contains 120 teeth, the change pinion 40, front-roller pinion 18, back-roller wheel 50 teeth, back-roller pinion 21, and middle-roller pinion 16 teeth, the diameter of the front roller 1 inch, and diameter of middle roller $\frac{7}{8}$th inch. Find the draft.

$$120 \times 50 \times 16 = 96{,}000 \div (18 \times 40 \times 21 \times \tfrac{7}{8}) = 7{\cdot}25$$
the draft.

Rule 28.

To find the draft between the back and middle rollers of a ring frame. For a dividend multiply the wheel on back roller driving the double carrier by the diameter of middle roller. For a divisor multiply the wheel on middle roller driven by the carrier by the diameter of the back roller. The answer will be the draft.

Example.

On a ring frame the back-roller pinion has 21 teeth and is driving by means of a double carrier, a 16 middle-roller pinion; and if the back roller is 1 inch diameter and the middle roller $\frac{7}{8}$th inch diameter. Find the draft.

$$21 \times 7 \div (16 \times 8 = 128) - 1 \cdot 148 \text{ draft.}$$

These two rules on draft discover where the draft is and to what amount. For instance it was found that the total draft was 8·3, as per Rule 7. By Rule 27 we find a draft of 7·25 is shown between the front and middle rollers, and by Rule 28 1·148 of a draft is shown between the back and middle rollers. To prove their correctness the two drafts must be multiplied together.

$$7 \cdot 25 \times 1 \cdot 148 = 8 \cdot 33300 \text{ total draft.}$$

Rule 29.

To find number of turns of the spindle to one of the tin roller divide diameter of tin roller by diameter of spindle-wharve. For a dividend multiply the diameter of the tin roller by 8 to bring it to $\frac{1}{8}$th of an inch. For the divisor take diameter of spindle-wharve in $\frac{1}{8}$th. The answer will

be the turns of the spindle to one of the tin roller without any allowance for slipping of spindle bands.

Example.

The tin roller of a ring frame is 10 inches diameter and the spindle-wharve $\frac{7}{8}$th inch diameter. What will be the turns of the spindle to one of the tin rollers?

$$10 \times 8 \div 7 = 11{\cdot}42 \text{ turns of the spindle.}$$

This will be found useful as far as exercise goes, but in practice it will be needed only when making out specifications.

Rule 30.

To find a twist wheel on a ring frame that has a double or compound twist wheel, and to change the gearing wheel. For a dividend multiply the present tin-roller wheel by the present twist wheel. For a divisor take tin-roller wheel intended to be geared. The answer will be the twist wheel required to put the same turns per inch in the yarn after the alteration, as were put in before the alteration.

Example.

On a ring frame there is a compound tin-roller wheel of 35 and 55 teeth, and twist of 44 teeth; and 35 is at present geared, but it is required to change from 35 to 55. Find twist wheel required.

$$35 \times 44 \div 55 = 28 \text{ wheel required.}$$

This will be found a very useful rule in all frames having a compound driving wheel.

Rule 31.

To find number of inches delivered by front roller for one revolution of the tin roller. For a dividend take turns of the spindle for one of the tin roller. For a divisor take turns per inch. The answer will be the amount delivered by front roller for one revolution of the tin roller.

Example.

On a ring frame the turns per inch being put in are 22·67 and the turns of the spindle for one of the tin roller are 11·42. Find inches delivered.

$$11{\cdot}42 \div 22{\cdot}67 = {\cdot}503, \text{ or say, } \tfrac{1}{2} \text{ inch.}$$

Or the following:—

For a dividend take the turns of the spindles for one of the front roller. For a divisor take turns of the spindle for one of the tin roller. Proceed as in simple division and use the answer for a divisor in the second part of the calculation. For a dividend in the second case, take circumference of front roller. The answer will be the amount delivered by the front roller for one turn of the tin roller.

From these particulars find amount delivered by front roller for one turn of the tin roller.

1st case.

$71{\cdot}24 \div 11{\cdot}42 = 6{\cdot}23$, 1st answer and divisor in 2nd case.

2nd case.

$$3{\cdot}1416 \div 6{\cdot}23 = {\cdot}504, \text{ or say } \tfrac{1}{2} \text{ inch.}$$

These rules which relate to the amount given out in a given time, or to a given number of revolutions, enable the

operator to understand the work that each section of the machine is accomplishing, and will also be found useful when it is required to make out a specification for new frames.

Rule 32.

To find the diameter of yarn. For a dividend multiply the number of yards in a hank by the counts of the yarn. Extract the square root. Then deduct 10 per cent, by multiplying by 90 and dividing by 100. The answer will be the diameter of the yarn. Find diameter of 42's yarn.

Example.

$840 \times 42 = 35280$

Square 35280 | 187 root
1

28) 252
224

367) 2880
2569

311

$187 \times 90 \div 100 =$
168 diameter of 42's.

It may be difficult to some to grasp this rule and to appreciate its value. The rule is valuable because it gives a knowledge of the number of ends of a certain number of counts of yarn which can be put side by side in a 1-inch space; take 42's for example; it should be possible to fix 168 ends in a space of 1 inch.

The explanation of the rule is as follows: as there are 840 yards in a hank, in multiplying this by the counts,

the product will be the square from which the root is required to be extracted.

Rule 33.

To reduce English counts to French counts. Take the English counts and divide by 1·18. The answer will be the French counts.

Example.

Find what 32's English counts would be in French numbering.

$$32 \div 1{\cdot}18 = 27 \text{ French counts.}$$

To bring French counts to English, multiply by 1·18.

A TABLE OF COTTON MEASURE.

Inches.	Threads.	Leas.	Hanks.	Doffings.
54	1	–	—	—
4,320	80	1	—	—
30,240	560	7	1	—
604,800	11,200	140	20	1

A TABLE OF WEIGHTS TO TRY THE COUNTS OF YARN.

Grains	dwt.	oz.	lb.
24	1	—	—
$437\frac{1}{2}$	$18\frac{11}{48}$	1	—
7,000	$291\frac{16}{24}$	16	1

A Table of Squares and Roots in Decimals used for Various Calculations.

	Square Root		Square Root.		Square Root.
1	1	35	5·916	68	8·246
2	1·414	36	6	69	8·306
3	1·732	37	6·082	70	8·366
4	2	38	6·164	71	8·426
5	2·236	39	6·244	72	8·485
6	2·449	40	6·324	73	8·544
7	2·645	41	6·403	74	8·602
8	2·828	42	6·480	75	8·660
9	3	43	6·557	76	8·717
10	3·162	44	6·633	77	8·774
11	3·316	45	6·708	78	8·831
12	3·462	46	6·782	79	8·888
13	3·605	47	6·855	80	8·944
14	3·741	48	6·928	81	9
15	3 873	49	7	82	9·055
16	4	50	7·071	83	9·110
17	4·123	51	7·141	84	9·165
18	4·242	52	7·211	85	9·219
19	4·358	53	7·280	86	9·273
20	4·472	54	7·348	87	9·327
21	4·582	55	7·416	88	9·380
22	4·690	56	7·483	89	9·433
23	4·795	57	7·549	90	9·486
24	4·898	58	7·615	91	9·539
25	5	59	7·681	92	9·591
26	5·099	60	7·745	93	9·643
27	5·190	61	7·810	94	9·695
28	5·292	62	7·874	95	9·746
29	5·384	63	7·937	96	9·797
30	5·477	64	8	97	9·848
31	5·567	65	8·062	98	9·899
32	5·666	66	8·124	99	9·949
33	5·744	67	8·185	100	10
34	5·830				

A Table of Breaking Weights per Lea in lb.

Hank of Yarn.	Weft		Twist.		
	Fair.	Good.	Fair.	Good.	Very Good.
10	150	160	160	180	200
11	136·3	145	145	163·6	181 8
12	125	133·3	133·3	150	166 6
13	115·3	123	123	138 4	154 6
14	107 1	114 2	114·2	128 5	142·8
15	100	106 6	106·6	120	133 3
16	93·7	100	100	112 5	125
17	88·2	94 1	94·1	105 8	117 6
18	83 3	88 8	88·8	100	111·1
19	78 9	84·2	84·2	94 7	105·2
20	75	80	80	90	100
21	71·4	76·1	76·1	85 7	95·4
22	68·1	72·7	72·7	81 8	90 9
23	65 2	69·5	69·5	78 2	86 9
24	62 5	66·6	66 6	75	83 3
25	60	64	64	72	80
26	57 4	61·5	61 5	69 2	76 9
27	55·5	59 2	59·2	66 6	74
28	53 5	57 1	57·1	64·2	71·4
29	51·7	55·1	55·1	62	68 9
30	50	53	53	60	66 6
31	48·4	51·6	51·6	58	64·5
32	47	50	50	56	62 5
33	45·4	48 5	48·5	54 5	60·6
34	44·1	47	47	52 9	58·8
35	42·8	45 7	45 7	51	57 1
36	41 6	44 4	44 4	50	55·5
37	40 5	43	43	48 6	54
38	39 4	42	42	47 3	52 6
39	38·4	41	41	46	51 2
40	37·5	40	40	45	50
41	36·5	39	39	44	48·7
42	35 7	38	38	43	47·6
43	34 8	37	37	42	46 5
44	34	36·3	36·3	41	45·4
45	33·3	35·5	35 5	40	44 4
46	32·6	34·7	34·7	39	43·4
47	31·9	34	34	38 3	42 5
48	31·2	33 3	33·3	37·5	41·6
49	30·6	32 6	32·6	36·7	40·8
50	30	32	32	36	40
51	29·4	31	31	35·3	39·2
52	28·8	30·7	30·7	34·6	38·4
53	28·3	30	30	34	37 7
54	27·7	29·6	29·6	33 3	37
55	27·2	29	29	32·7	36·3
56	26·7	28·5	28·5	32	35·7
57	26·3	28	28	31·4	35
58	25·8	27·5	27 5	31	34·4
59	25·4	27	27	30·5	33·8
60	25	26·6	26·6	30	33·3
61	24·5	26·2	26·2	29·6	32·8
62	24·1	25·8	25·8	29	32·2
63	23·8	25·3	25·3	28·5	31 7
64	23·4	25	25	28·1	31·2

A TABLE TO FIND THE COUNTS OF YARN BY THE WEIGHT OF 1, 2, 3, OR 4 LEAS.

Counts.	One Lea. Oz.	One Lea. Dwt.	One Lea. Gr.	Two Leas. Oz.	Two Leas. Dwt.	Two Leas. Gr.	Three Leas. Oz.	Three Leas. Dwt.	Three Leas. Gr.	Four Leas. Oz.	Four Leas. Dwt.	Four Leas. Gr.
1	2	5	5	4	10	10	6	15	15	9	2	14·50
2	1	2	14·50	2	5	5	3	7	19·50	4	10	10
3		13	21·23	1	19	13·16	2	5	5	3	—	20·83
4		10	10	1	2	14·50	1	13	0·50	2	5	5
5		8	8		16	16	1	6	18·50	1	15	2·50
6		6	22·66		13	21·32	1	2	14·50	1	9	13·16
7		5	22·85		11	21·71		17	20·57	1	5	13·92
8		5	5		10	10		15	15	1	2	14·50
9		4	15·11		9	6·22		13	21·33	1	—	6·94
10		4	4		8	8		12	12		16	16
11		3	18·90		7	13·80		11	8·72		15	3·63
12		3	11·33		6	22·66		10	10		13	21·33
13		3	4·92		6	9·84		9	14·77		12	19·69
14		2	23·43		5	22·85		8	22·28		11	21·71
15		2	18·66		5	13·33		8	8		11	2·66
16		2	14·50		5	5		7	19·50		10	10
17		2	10·83		4	21·64		7	8·47		9	19·29
18		2	7·55		4	15·11		6	22·66		9	6·22
19		2	4·63		4	9·26		6	13·89		8	18·52
20		2	2		4	4		6	6		8	8
21		1	23·62		3	23·23		5	22·85		7	22·47
22		1	21·45		3	18·90		5	16·36		7	13·81
23		1	19·47		3	14·95		5	10·43		7	5·91

Cts.	One Lea		Two Leas.		Three Leas.		Four Leas.	
	Dwt.	Gr.	Dwt.	Gr.	Dwt.	Gr.	Dwt.	Gr.
24	1	17·66	3	11·33	5	5	6	22·66
25	1	16	3	8	5	—	6	16
26	1	14·46	3	4·92	4	19·38	6	9·84
27	1	13	3	2	4	15·11	6	4·14
28	1	11·71	2	23 42	4	11·14	5	22·85
29	1	10·48	2	20·99	4	7·44	5	17·93
30	1	9·33	2	18·66	4	4	5	13·33
31	1	8·26	2	16·51	4	0·77	5	9·03
32	1	7·25	2	14·50	3	21 75	5	5
33	1	6·30	2	12·60	3	18·90	5	1·21
34	1	5·41	2	10·82	3	16·23	4	21·64
35	1	4·57	2	9·14	3	13·71	4	18·28
36	1	3·77	2	7·55	3	11·33	4	15·11
37	1	3	2	6·05	3	9·08	4	12·10
38	1	2·31	2	4·65	3	6·94	4	9·26
39	1	1·63	2	3·28	3	4·92	4	6·56
40	1	1	2	2	3	3	4	4
41	1	0·39	2	0·78	3	1·17	4	1·56
42		23·80	1	23·61	2	23·42	3	23·23
43		23·25	1	22 51	2	21·76	3	21·02
44		22·75	1	21·45	2	20·18	3	18·90
45		22·22	1	20·44	2	18·66	3	16·88
46		21·73	1	19·47	2	17·21	3	14·95
47		21·27	1	18·55	2	15·83	3	13·10
48		20·83	1	17·66	2	14·50	3	11·33
49		20·40	1	16·81	2	13·22	3	9·63
50		20	1	16	2	12	3	8
51		19·60	1	15·21	2	10·82	3	6·43
52		19·23	1	14·46	2	9·69	3	4·92
53		18·86	1	13·73	2	8·61	3	3·47
54		18·51	1	13·03	2	7·55	3	2·07
55		18·18	1	12·36	2	6·54	3	0·72
56		17·86	1	11·71	2	5·57	2	23·42
57		17·54	1	11·08	2	4·63	2	22·17
58		17·24	1	10·48	2	3·72	2	20·96
59		16·94	1	9·89	2	2·84	2	19·79
60		16·66	1	9·33	2	2	2	18·66

Counts of Traveller.

As regards what counts of traveller should be used for certain counts of yarn, speed of spindle, and size of ring, no definite answer can be given. The following table will give some idea of the general practice.

Each must use his own judgment as to how far other conditions, such as quality of material, etc., necessitate variations from the following table. It will be noticed that as the ring increases in diameter the weight of the traveller also increases.

Counts of Yarn.	Diam. of Ring, 1½ in.	Diam. of Ring, 1¾ in.
	Counts of Traveller.	Counts of Traveller.
2	16	15
4	14	13
6	12	11
8	11	10
10	9	8
12	8	7
14	7	6
16	6	5
18	5	4
20	4	3
22	3	2
24	2	1
26	1	1/0
28	1/0	2/0
30	2/0	3/0
32	3/0	4/0
34	4/0	5/0
36	5/0	6/0
38	6/0	7/0
40	7/0	8/0
42	8/0	9/0
44	8/0	10/0
46	9/0	10/0
48	10/0	11/0
50	11/0	12/0
52	12/0	13/0
54	13/0	14/0
56	14/0	15/0
58	15/0	16/0
60	16/0	17/0

A Table of Spindle Gauges, Diameters of Rings, for Certain Ranges of Counts.

Counts of Yarn	Spindle Gauge.	Diameter of Ring.
4 to 20	$2\frac{5}{8}$ inches.	$1\frac{3}{4}$ inches.
20 to 40	$2\frac{1}{2}$,,	$1\frac{5}{8}$,,
Over 40	$2\frac{3}{8}$,,	$1\frac{1}{2}$,,
Weft	$2\frac{1}{4}$,,	$1\frac{1}{4}$,,

Ring-spinning Frame Specifications.

No. of Frames.

To stand in what length, including driving pulleys.

How many spindles in each frame?

Distance between spindles.

Kind of spindle.

Speed of spindle.

Spindle to run twist or weft warp.

Diameter of spindle wharve

Length of lift.

Inside diameter of ring.

Kind of ring.

Diameter of bottom lines of rollers :—

Front,	inches	usually $\frac{7}{8}$ or 1 inch.	
Middle,	,,	,, $\frac{3}{4}$	,,
Back,	,,	,, $\frac{7}{8}$	,,

If the front line of rollers is to be case hardened, or only the necks (to be case hardened).

Diameter of the rollers :—

Front,	inches	usually $\frac{3}{4}$ or $\frac{7}{8}$	inch.
Middle,	,,	,, $\frac{3}{4}$	,,
Back,	,,	,, $1\frac{3}{4}$	inches.

Back line of rollers to have corrugated or common flutes.

If top line of front rollers to be loose boss, if so extra per spindle.

Conical or parallel top clearers.

Total draft of fluted rollers.

Draft from front to middle rollers.

Draft from middle to back rollers.

Distance from centre to centre of rollers.

Front to middle smallest distance . . . inches to open to . . inches.

Middle to back smallest distance . . . inches to open to . . . inches.

Top rollers dead weight for front line is usually about 7 lb.

Or all three lines weighted by saddles, levers, and weights.

If middle and back rollers are to be weighted by saddle and lb. weight at per spindle.

How many revolutions of spindle for one of the front roller?

Or how many turns per inch?

What counts will you spin?

What hank roving?

Single or double roving.

Will you have one height of creel or two heights?

Creel to be of wood or iron.

If suitable for iron pegs and tin tubes or wood skewers.

Single or double tin rollers.

Diameter of tin rollers.

Facing gearing end must tin rollers run to right or left?

Width of frame. Hand of frame.

Revolutions of main or line shaft per minute.

Diameter of drum on line shaft.

Diameter of driving pulley inches, usually 15 inches.

Will frame be driven from above or below?

Patent balooning motion Extra.

Hank Indicators. Extra.

Rope driving to connect tin rollers with tension screw, etc. Extra.

Is a complete set of change wheels wanted for each frame, or how many?

Change wheel wanted.

Draft pinions No. of teeth to

Twist pinions No. of teeth to

The spare wheels supplied with each frame without any extra charge are:—

Draft pinions 4.

Twist pinions 4.

Top rollers 6.

When must the frame be delivered and how?

Table of Twist per inch for Ring Spinning.

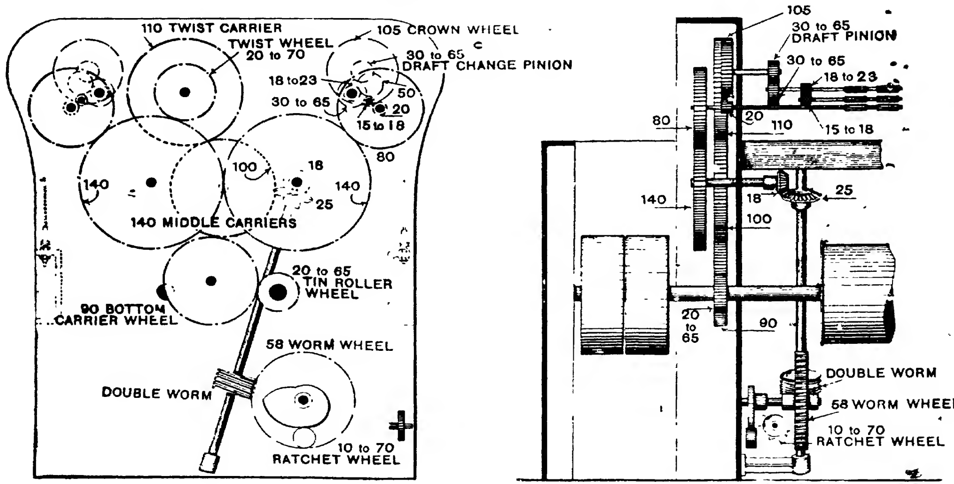
Twist × $\surd$ counts by 4.

Weft × $\surd$ counts by 3·50.

Weft for doubling × $\surd$ counts by 3.

Hard and extra hard twist by 5 to 6.

PLAN OF RING-SPINNING FRAME SHOWING NUMBER OF TEETH IN VARIOUS WHEELS AND THE POSITION THEY OCCUPY.



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